at the third station only managed to obtain some results at third contact, the weather being very unfavourable.

At Fort de Kock, in addition to some beautiful corona pictures (one of which is here reproduced for comparison in Fig. 1) taken with the 40-feet coronagraph, used horizontally in this eclipse, photographs were secured with the 30-feet concave grating. In the latter, films were used in consequence of the sharp curve in the focal plane of the grating, but, as the report says, "each film showed that, unfortunately, it had not been placed exactly in focus, still the dispersion was so great that many of the lines could be very easily identified." A table is given showing the results obtained from the measures of these negatives, the spectrum covering λ 3118.5 to λ 5204.7; intensities, character, and wave-lengths from Rowland's tables are also included.

At Sawah Loento the plane grating proved a success, parallel rays falling on its surface and being brought to a focus on the photographic plate by means of a lens placed between the grating and the plate. In spite of clouds, the negative taken at third contact is said to have been fully exposed. The large dispersion employed and the definition obtained allowed very accurate wave-lengths to be deduced, so that the table of wave-lengths extending from λ 3835.2 to λ 4957.8 will be very valuable to compare with those made by other observers.

The discussion of these results is here carried to some length, but space does not permit of any extensive reference. It may, in the first place, be said that both Mr. Jewell and Dr. S. A. Mitchell record having observed the magnesium (λ 4481) line in the photograph of the chromospheric spectrum, and both agree in the determination of the wave-length, intensity, and length of arc. It is described as being stronger in the chromospheric spectrum than in the ordinary solar spectrum. The presence or absence of this line in the chromospheric spectrum is a point of such great importance that the observation above described requires to be very carefully corroborated before it can be finally accepted. It is, however, very difficult to understand how the above identification of the magnesium line with the chromospheric line has been obtained, because in the list of wave-lengths here published the evidence seems to point to a titanium origin. Thus we find in this table that the wave-length of the chromospheric line, as measured, is λ 4481.4, while the solar lines nearest this are, according to Rowland, λ 4481.298 (Mg) and λ 4481.438 (Ti). Further, has it been definitely established that the solar line λ 4481.298 is due to magnesium?

It is also stated that it seems probable that the more volatile gases of atmospheric air uncondensed at the temperature of liquid hydrogen, together with hydrogen, helium, neon, and argon, are present in the chromosphere, but with regard to krypton and xenon the evidence is not conclusive. These deductions also do not seem to be supported by sufficient evidence, but will require further discussion before they can be generally accepted.

Enough, perhaps, has been said to indicate to the reader the importance to the study of solar physics of the publication of such a volume as this. Here we have all the data and discussions relative to two eclipses brought together under one cover, rendering a comparison of results a matter of little labour. One blemish we may, however, remark, and that is that the corona reproductions are not oriented in any way.

It may be still in the minds of our readers that, for the observation of the recent eclipse of 1905, Admiral Chester, Commander-in-Chief U.S. Eclipse Squadron, was in command of four men-of-war told off for eclipse work in Algeria and Spain. Their "station bills," showing the staff at each station and the work to be accomplished, gave one a good idea of the thoroughness with which the undertaking was organised. We shall at any rate look forward to another such volume as this, with, we hope, equally successful results. WILLIAM J. S. LOCKYER.

AGRICULTURE AND THE EMPIRE.

NATURE for January 11 contains a short paper on a large subject. Seeing that the cultivation of the soil, or agriculture, is the fundamental condition of human existence with any approach to civilisation, large is a very moderate description.

I take it that the object of the writer was to discuss the part that the Home Country should play in advancing agriculture in the Empire at large. That is a matter which seems to me important enough to receive a little discussion. It is one with which I have been a good deal occupied during the past thirty years. I should like, therefore, to attempt to define the present position of the problem a little more precisely.

May I begin with a very obvious remark? Agriculture is a sort of "noun of multitude." There is undoubtedly only one agricultural science based on physiological principles; there are many agricultural "arts" based on the application of that science, whether empirical or otherwise, to widely different physical conditions. The agriculture of the Lothians differs widely from that of Bengal, and both differ from that possible on the Gold Coast. This will seem to many an absurdly trite remark. Nevertheless, experience shows that it represents a fact which has often been overlooked, with loss and disappointment as the result.

It may, I think, be confidently stated that arable cultivation has been brought in the British Isles to a pitch of perfection which is not surpassed anywhere in the world. It is, however, an "intensive" and highly specialised agriculture. This is readily illustrated by the yield of wheat per acre. On land of prairie value, where the nitrogen removed is balanced by that received from the atmosphere, it has been shown at Rothamsted that the yield is roughly some 10 bushels or less. This actually represents the state of things in the great wheat-growing countries from which we draw our supplies—Argentina, Australia, India and Russia—and the United States with 13 bushels are not much better. The yield of the United Kingdom for the five years preceding 1904 was 31 bushels, and this was only surpassed by that of our antipodal colony New Zealand, 32.

This is largely due to the scientific research in agriculture for which, I think, it may be fairly claimed this country has always been preeminent. I by no means think that it is exhausted. I remember Sir John Lawes saying to me that, having devoted half a century to the study of the soil actually cultivated, he was still absolutely ignorant as to the subsoil and the part played by it. Our knowledge of the action of manures is mainly empirical, and we have still to learn much of its physiological significance. Without this it cannot be said that we possess a rational theory of manuring. Farmers must have wasted enormous sums in the application of nitrogenous manures until Frankland showed that a considerable proportion passed off unused in the drain-water.

I must confess that I am not clear that the arable agriculture of the United Kingdom is in a backward condition, that it does not compare favourably with that of other countries, or that it stands in urgent

need of Government aid in regard to research. Its theoretical principles can be taught in our universities and schools; its practice can only be learnt on the farm. While saying this I must also express my conviction that the agricultural wealth of this country might be increased in many ways. In my evidence before the recent departmental committee on fruit culture I expressed a strong opinion that the condition of that industry was in no way creditable to us.

At the moment, where, so to speak, the shoe pinches is not above but below. There is no dearth of scientific knowledge in the country, but it floats on the surface and does not permeate. The scientific and even practical ignorance of the small cultivator is profound. The Board of Agriculture and Fisheries has tried to grapple with this by the wholesale distribution of carefully prepared leaflets. But such a method of disseminating knowledge is of almost heart-breaking difficulty. I have had prepared at Kew a series of diagrams illustrating the diseases of trees, suitable for schools. The *Daily Graphic* was good enough to say that:—"This publication is equal to the very best of those ever sent out by the United States Department of Agriculture." Yet the sale has been disappointing, and the Board of Agriculture and Fisheries does not see its way in consequence to proceed with the further and still more needed series dealing with the diseases of fruit trees. The crying need, in my judgment, at the moment is the introduction of intelligent cultural instruction into rural elementary schools.

If we turn to India we have to face a difficult problem. The revenue is dependent on the land, and this in turn has to support a constantly increasing population. It has been supposed that this might be met by the use of British methods. But how? Sir James Caird, who was sent out to study the problem on the spot, reported that if the produce of the land could be increased by 1 bushel per acre, all would be well. No doubt; but how is this intensive cultivation to be accomplished? Long cultivation has brought the land down to a condition of nitrogen-equilibrium. Dung is used as fuel, and the cultivator is too poor to import artificial manures.

In 1900 I attended a conference at the India Office on the qualifications of an Inspector-General of Agriculture. The report of the proceedings is printed in the Blue-book of the Botanical Work Committee (pp. 77–78). I stated then, and the statement met with general assent, "It would be the greatest mistake to substitute for Indian agricultural practices western methods, merely because they had succeeded in the west. . . . The problem in India was how best to graft the results of scientific agricultural knowledge on to the stock (the really valuable stock) of Indian agricultural practice and experience."

India has long had experimental farms in plenty. They have not been without their usefulness. But they have lacked permanence and a guiding principle. It now owes in great measure to the munificence of an American gentleman an agricultural research institute at Pusa. It is further, I believe, intended to establish a number of subordinate stations at a cost of 250,000*l*. If these are to be staffed from home *forthwith*, the result will be very much what the Transvaal Director of Agriculture points out. The Government of India should at once make up its mind what appointments it proposes ultimately to make, and inform the universities at home five years in advance. Students at the universities cannot be expected to engage in agricultural or allied studies unless they see clearly what is to come of it at the end.

Let me turn now to the problem presented by the West Indies and other of our tropical possessions. Sir Daniel Morris is quoted as saying in regard to the former:—"Agricultural education is at the root of the successful development of these Colonies." This is perfectly true, only I rather doubt whether the writer of the article quite understood the reason. In temperate countries agriculture is a necessity of existence; in many tropical countries it is not. The wasteful production of a few ground provisions calls for the minimum of effort, and is sufficient to sustain indolence. But with the introduction of orderly government a revenue becomes necessary. Sir Charles Bruce has laid it down that "in the Crown Colonies generally . . . the only taxable fund is the wage fund supplied by the annual proceeds of the cultivation of the land" (Proc. Colonial Institute, vol. xxxvi., p. 248). To induce the negro to engage in profitable cultivation instead of contenting himself with a bare modicum of ground provisions provides a source of revenue, raises his standard of comfort, and makes for his moral progress. But he has to be taught by example how to do it, and this is the agricultural education which Sir Daniel Morris had in his mind. It is widely different from anything of the kind in this country.

In point of fact, tropical agriculture has little relation to that of temperate countries. Its methods are those of horticulture; it is essentially extended gardening. For the supply of men for this purpose our agricultural colleges would be of little or no use. The problem has had to be met in a wholly different way. The machinery for the purpose is compendiously described in the following extract from the Colonial Office List (p. xx.):—"'Botanic Stations' . . . are small and inexpensive gardens, devised in 1885, in order to afford practical instruction in the cultivation of tropical crops, and were intended to develop the agricultural resources at first of the smaller West Indian Islands, and subsequently (1887) of British possessions in Tropical Africa. Each is in charge of a Curator, who is a gardener trained at Kew."

The sort of success that has attended the system may be illustrated by a single example. Cacao was introduced to the Gold Coast from Kew. In 1891 the export was valued at 4*l*. In 1900 I was able to exhibit at the Paris Exhibition from the botanic station the first sample, to the best of my belief, grown on the African continent, when it received a bronze medal. In 1904 the export had risen to a value of more than 200,000*l*. In effect, cacao is exchanged for imported goods; besides thus adding to the comfort of the cultivators, it enables them to pay the taxes necessary to maintain peaceful government.

For work of this kind the Empire has to depend on Kew, which is organised for the purpose as an advanced horticultural school. At the present moment some seventy Kew men are in official employment and carrying on the work I have described in our various tropical colonies and possessions.

But besides native peasant cultures British capital and enterprise are also largely embarked in the tropical regions of the Empire in "planting industries." These meet with difficulties which the local Government can and does supply skilled aid to mitigate. Most of the West Indian colonies have a "Government analyst." Cambridge has secured the traditional right to train and supply these. Incidentally they are able to give important aid in dealing with agricultural problems. The value of the work done by Prof. Harrison in British Guiana and Prof. d'Albuquerque in Barbados can hardly be overestimated.

Ceylon possesses an almost unique staff of trained

experts of every kind at Peradeniya, and a similar organisation is in process of establishment in the Federated Malay States. The rubber industry of the Straits Settlements owes its success to the Director of Public Gardens at Singapore. Besides Pusa, India has experienced botanical experts, all university men, at Calcutta, Madras, and Saharunpore.

Our self-governing colonies know pretty well how to take care of themselves. All possess agricultural departments and produce journals which will compare more than favourably with anything at home. In Canada the Central Experimental Farm at Ottawa is certainly not eclipsed by any institution in the United States. I may be pardoned a little vanity if I remark that when the Transvaal Government applied to Washington for an agrostologist it received a Kew man.

To sum up. What the Home Country can supply to the Empire is:—(1) cultural instructors such as are trained for the purpose at Kew; (2) men with a sound scientific training and a firm grasp of the principles underlying agricultural practice of whatever kind, and for these we must look to the universities. Men who are merely familiar with British agricultural conditions will be mostly of little use unless they possess the flexibility of mind which will apply theory to new and unfamiliar conditions.

W. T. THISELTON-DYER.

NOTES.

THE position of the South Africa medal fund for the endowment of a medal and scholarship or studentship in commemoration of the visit of the British Association to South Africa in 1905 is stated in a circular just issued by Prof. J. Perry, honorary treasurer to the fund. The subscriptions promised or paid amounted to 752*l.*; and to this the council of the British Association has resolved to add the unexpended balance of the special South African fund, amounting to about 800*l.* The following report of the executive committee was adopted at a meeting of subscribers on March 2, and approved by the council of the British Association:—(*a*) That the fund be devoted to the preparation of a die for a medal to be struck in bronze, 2½ inches in diameter, and that the balance be invested and the annual income held in trust; (*b*) that the medal and income of the fund be awarded by the South African Association for the Advancement of Science for achievement and promise in scientific research in South Africa; (*c*) that, so far as circumstances admit, the award be made annually. It is to be hoped that a fund raised for so excellent a project will receive a substantial increase from members of the association who have not already contributed to it, or from subscribers who may wish to add to their subscriptions.

THE terrible mine explosion at Courrières, in the Pas de Calais, on the morning of March 10, involving the loss of about 1200 lives, has naturally led to all sorts of conjectures as to the immediate cause. As usual, atmospheric conditions are said to have played a not unimportant part in bringing about the tragedy. In some mysterious way the very low barometric pressure over the North Sea on March 12, two days later, is supposed to explain the disaster. If, however, attention is concentrated on the atmospheric conditions prevailing at the time of the accident, it will be found that they resembled those which have accompanied the majority of the great disasters of the past fifty years. The *Bulletin météorologique de France* shows that during the night of March 9 a well marked anticyclone extended from Spain in a north-easterly direction across France and the Netherlands, so that at 7 a.m. on March 10, when the calamity occurred, the barometer over the Lens district had risen to 765 mm. (30·1 inches); it had, in fact, mounted nearly a quarter of an inch in the course of the night. Obviously, if atmospheric pressure played any part in bringing about the catastrophe, the latter cannot in any way be associated with a low and falling barometer.

THE death of Mr. William Sowerby, for many years secretary of the Royal Botanic Society, Regent's Park, occurred at his residence in Hertfordshire on March 9. A grandson of James Sowerby, the famous illustrator of "English Botany" and of "British Conchology," and son of James de Carle Sowerby, another gifted naturalist, Mr. W. Sowerby inherited the family taste for natural history. He was responsible for the drawing of some botanical plates, but early in life he became associated with the Royal Botanic Society through his father, who was a founder and the first secretary, and in Regent's Park he worked for half a century. An observation which brought his name prominently before the public was the discovery of a medusa in the Victoria Regia tank, this being the first record of a medusa in fresh water, not to say in a most unexpected locality. He was keenly interested in economic plants, and not only did he bring together a unique collection, but he obtained fruit and fibre, the latter being distributed on several occasions to commercial men for trial. Among his successful experiments was the cultivation of the white mangrove, Avicennia, that flourished and produced aërial roots in artificial brackish water; he also demonstrated that seaweeds could be grown in tanks in the greenhouses.

IT is reported from Tokio that a severe earthquake has occurred at Kagi, in Formosa. Many hundreds of persons have been killed and injured, and a large number of buildings have been destroyed.

A REUTER message from New York states that, according to advices from Honolulu, a volcano in Savaii Island (Samoa) is in eruption on a large scale. Three villages have been completely destroyed, including Maleda. The lava stream is three-quarters of a mile wide, and is flowing into the sea.

DR. H. C. BASTIAN, F.R.S., gave a demonstration, with the aid of lantern slides, "On some Heterogenetic Processes," on March 15 at the rooms of the Medical Society. Various micro-organisms were exhibited with the view of meeting the objections that have been raised to Dr. Bastian's interpretations of the transformations observed. An account of Dr. Bastian's remarks is given in the *Lancet* for March 17.

THE secretary of the Decimal Association informs us that he has within the past few days received fifty-three promises of support from newly elected members of Parliament. In the last parliament there were 330 members pledged to support the adoption of the metric weights and measures in this country, and at the present time 253 votes can be relied upon in the House of Commons. Additional assents are being received day by day, and it is probable that when the canvass now proceeding has been completed there will be as many supporters in the present parliament as there were in the last.

THE report of the late Dr. S. P. Langley, secretary of the Smithsonian Institution, Washington, for the year ending June 30, 1905, shows that much valuable scientific